

Ya.Z.Grinberg THE CONCEPTS OF ELECTRO-THERAPY

The problems of electrotherapy, I would imagine, are mainly solved. It is enough to refer to monographs [1,2], textbooks [3], catalogues of leading firms [4] and observation [5].

The basis of therapeutic, pain-killing and other effects in electrotherapy is the neuro-reflective mechanism with the participation of the neuro-humor link, as a result of local, segmental and general reactions [1,2]. Various theories of the management of pain (collar control, endogenous opiates and others [5]) are, in fact an interpretation of the above mentioned action mechanism.

The approach described earlier allows the use of practically any (limited usually only by empirically detectable permissible dosages) electrical influence (action) for treatment. Their variety is justified by a concept of specificity of the influence by the physical factors on the organism.

It is said, that correlation of reactions of the organism from the specific features of the physical factors allows them to be used differentially for the single-minded control of the physiological functions, or for their normalisation in case of disturbance in the pathological processes.

Accordingly, the uses of a great number of methods (and apparatus) are recommended. For the chosen modes there are offered various forms of action in actual nosology. For example, there are offered up to 18 varieties of the influencing currents in the devices for electrotherapy [4]. In a similar way, it justifies the variety of trans-skin stimulators [5]. At the same time, tendencies in the development of electrotherapy and also recommendations to increase its effectiveness, to a greater degree, do not correspond to a described variety. For example, an impulse action is recommended.

This is due to liability of the nerve cells, the necessity of concentration of energy in impulses and by providing a non-damaging action [2,6]. Neither galvanic current, nor Bernard's current, nor interference current, nor amply-pulse-therapy corresponds.

Development of the methods of electrotherapy demonstrates a tendency in reaching a higher therapeutic effect with the least action, with increasing of the "informational" and diminishing "energetic" component of the action (the concept of "small dosage"). Variety of the currents which were listed above (galvanic also) do not correspond to this. At the same time, low-energy methods of reflexotherapy, (not necessarily electrical) allow good results for many diseases [7] at similar mechanisms of treatment effect [7,8,9].

As a matter of fact, adopted concepts of electrotherapy do not use the general approach of comparing methods and methodises with each other and do not solve the dosage problem, making an orientation to the empirical approach and not to have a conditional character [5]. The main task of presenting work is to eliminate contradictions between theory and practice, explain their reasons, offer an approach, which will allow the comparison of methods with others and advance the solution of the problem - "dosage - effect". At the same time, we remain limited by neuro-reflexive mechanisms of action by the physical factors with participation of the neuro-humor link.

With regards to the modern concepts, we will look upon this as a united neuro-endocrine (neuro-immune-endocrine) system and consider that neuro-secretive cells are scattered around the different brain sections. Those cells are localising in the CNS and in the periphery of the NS. Accordingly, one stimulus is able to multiply on tens of the endocrine signals, which have got targets practically in any part of the body.

Neur	o-mediators	hormone	s (non-steroids)	steroids and T	"thyroid hormones
Membrane r	receptors Ion canals	Membrane	receptors	Cytozoon	receptors
Changing of the ingredients of the membranous potential		Second Chemical moc	ary mediators dification of Protein	m Synthesi	RNA s of protein

Pic 1

Physical action (in this case electro-action) is always a disturbance of homeostasis, possibly local. There is a hierarchy that exists inside the neuro-endocrine regulation, which is closely connected to the speed of developing and the speed of diminishing the hormonal signals. This regulation is also connected with the molecular mechanisms of their actions (pic.1). [10].

Where there is a deflection out of the norm of one or the other process of vital activity, the nervous system of the regulation will turn on first and neuro-mediators will be secreted. In return, by changing activity ion channels, they will cause hyper- or de-polarisation of the membranes. This regulation of cell activity (which is due to physical processes) develops and diminishes in fractions of seconds.

If it is not able to bring back one or the other factor of homeostasis to the norm, peptide hormones (non-steroids) will be activated. They act through the membranous receptors and the system of secondary mediators, which stimulate chemical modification of the proteins. This regulation is due to chemical processes, develops, and diminishes in tens of minutes.

If the deflection out of the norm, when one or another process of vital activity reaches dangerous bodily values, steroid and thyroid hormones will be activated, which are because of their specificity of the receptors can have an influence on the gene expression. This reaction is realised in 3 - 6 hours and diminishes in 6 - 12 hours after the deflection has started.

The growth factor takes an intermediate position. Its receptors are capable of penetrating into nuclei, which then leads to the proliferation of the cells.

Having studied possible reactions of the organism (in principle measurable) on the influence of the physical factor, it is make sense to raise a question: which reaction is making sense to provoke in order to achieve therapeutic effect?

On the basis of a proposed approach is a study of regulative continuum [11,9], according to which, the neuro-peptides (regulative peptides) together with other humor regulators provide compatible biological activities.

Peptides continuum (middle molecular background) detects the physiological state of the body when the severe stressor is in the process of shock, during neuro-humor regulation of the circulatory, respiratory, reproductive and gastro-intestinal systems [12,20]. Inflammation processes of any genesis and/or the interaction between the tumour and the organism are in changed conditions of peptides continuum [21,22].

At the same time of the unrolling of the peptid-ergic link of pathogenesis, the sanogenesis mechanism is forming: there is an accumulation of peptides with many functional spectrums of action and increasing

levels of vital activity. The maximum topicality of this mechanism falls on the period, when "defence" (especially with shock) goes too far (extra accumulation or accumulation of "unusual peptides" - quick oppression of the vegetative activity, terminal collapse). Therefore, ***electrotherapy (additional physical factor) is most effective when there is a change in the middle molecular background (peptide continuum)***. The action in its basis must provide a disturbance of homeostasis, which corresponds to reaction 1b, even though other local reactions are apparently not excluded.

The above mentioned allows comparisons to be made of the methods.

High-energetic methods (before all, continuing or close to them), due to their particularity, use their own physical action to cause an inflammation process. If the level of homeostasis disturbance corresponds to pie. 1, a change in the middle molecular background emerges, which is oriented before all, managing the inflammation process. Appropriate changes take place through blood and humor in the organism. If the content and the concentration of the middle molecular background are enough for the fight with pathology (for the aid for the organism in the fight with pathology) electrotherapy gives positive results.

Within the described model, let's pay attention to the two particularities:

1. Formed middle molecular background can be specific enough, as it is oriented before all, on managing the inflammation process, which was caused by this electrical influence.
2. The changing of the middle molecular background in some sense is "flawed", because it was caused by damage - disturbance of homeostasis, not dependent (or partly dependant) on changing the concentration of the middle molecules.

Once again, let's clarify the last point. Changing the concentration of the middle molecules is also a disturbance of homeostasis, but in high-energetic methods it is just a consequence, as in any pathological process.

Accordingly, high-energetic methods of electro-therapy directed as a fight with the pathological process, is also a fight with itself. This mainly determines it's deficiently high effectiveness, it's specificity and also a great number of contraindications.

Let's formulate now more precisely the concept of electrotherapy: ***the action must provide the required increase (accumulation) of peptides with a semi-functional, stress - limiting spectrum, provided that the damaging action of the electric signal is minimised.***

Non-damaging influence, according to an electro-physiological investigation [23, 6], is provided by a bipolar impulse signal, where each phase does not exceed 100 MSc. This mainly corresponds to the short-impulse analgesia devices (EENS, TENS) whose parameters have close values. It seems that they must have solved the set task.

However, this does not happen in practice. The reason for the low therapeutic effectiveness of these devices is the long-term adaptation of the organism to the action. This fact, known in electrotherapy [23, 24] is becoming a determinative. Exactly due to this, high-frequency low-intensity TENS gave way to low-frequency high-intensity [5]. (It is interesting that a consequence of the impulse frequency in low-frequency TENS (1-4 Hz), corresponds to the threshold of adaptation, as was achieved in the academic experiment [25, 24]). But! The problem of low-frequency TENS is, apparently, in the low frequency of the action.

Let's explain at this instance.

Imagine that we managed to remove an adaptation to the signal of high-frequency TENS and made it intensive, (not more then lower-frequency). At a frequency of 100 Hz, provided that other conditions are equal, the background of middle molecules will increase by 20 times more than, say, and frequency of 5 Hz. If high-frequency TENS (with absents of adaptation) need action on 60 zones for 10 sec each (10 minutes), then lower-frequency TENS will have to work for 3 hours 20 minutes.

It is not a coincidence, that low-frequency TENS are constructed with the aim of acting on the acupuncture points (places with a higher content of bioactive elements).

It is not a coincidence, that Burst-TENS are in use (low-frequencies TENS, which influence using sets of 7 impulses with an internal frequency of 100 Hz), and this, in fact, allows an increase in the frequency of the action and at the same time eliminates adaptation.

On the basis of what's written above, let's explain the present contradictions of electrotherapy.

1. High-energetic methods of electro-action keep their topicality, because the low-energetic (short-impulse) methods are not always able to provide necessary change in the middle molecular background.
2. High frequency (50 - 100 Hz) TENS do not give an adequate therapeutic effect because

the process of adaptation is present. Low-frequencies (1-4 Hz) - due to the low-frequency of the action, do not allow the required degree of change in the middle molecular background (i.e. do not allow the accumulation of enough neuro-peptides with their many functional spectrums of action).

3 Specificity of the action of the high-energetic methods, their damaging character, the presence of adaptation (independent from the energy of the influence), an insufficient activation of the nervous structures in the low-energetic methods, the dependence of the effectiveness of the electrotherapy on either functional state, or the methodical techniques, the complicity of the comparison of the effectual methods of electrotherapy - all this brought out a wide range of devices and methodises.

The proposed concept allows us not only to compare the methods and explain the contradictions, but also to produce the general requirements of the technical and methodical supplies.

Technically: there is a necessity to create (using terminology [5]) high frequency, high-intensity TENS. "High-frequency" is implemented here using common sense - a range of frequency limits of 50 - 100 Hz, using labile nervous system parameters.

"High intensity" is construed as being capable of producing (helping to produce) the effective dosage of the middle molecules. This is determined not only by the amplitude of current (better to say - density of current), but also by the creation of the "non-adaptive" signal. High amplitude and "non-adaptive" influence is necessary for the activation of the thin C-fibres. These form the biggest part of the nervous tissue, which takes part in the production of the effective (sufficient) dosage of the middle molecule [24].

Methodically: the influence should be applied on the zones of high enervation, zones of the projection of pathology (which, as known, accumulate a great number of the middle molecules) and a range of others zones that are determined in the process of action [25]. The criteria for completing the procedure, is an appearance of certain reactions during the procedure and, after working on these reactions, getting an alteration (dynamic) in the patient's condition.

Now, to summarise it all.

The electro-action must provide the necessary accumulation of the peptides with the semi-functional -spectrum of action in the organism, diminishing the damaging action of the stimuli itself.

The task is to solve the action of high-density impulses on the organism and eliminate the process of adaptation. Realisation of such an approach **excludes the necessity in the variety of methods and methodises of the electrotherapy. This approach explains theoretical and practical contradictions and allows an advance in the solution of the problem I dosage - effect. This approach opens the possibilities of a considerable increase in the effectiveness of electro-therapy and the expansion of the spectrum of usage.**

Exactly as pointed out, there is development of the devices from the series of SCENAR, produced by the company, ZAO OKB "Rhythm".

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